**This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.**

**If you have a suggestion to make the keys better, please fill out the short survey here.**

*Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.*

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1. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{-1386}{14}}$$

The solution is Not a Real number, which is option A.

A. Not a Real number

* This is the correct option!

B. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

C. Irrational

These cannot be written as a fraction of Integers.

D. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

**General Comment:** First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{99}i$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

2. Simplify the expression below and choose the interval the simplification is contained within.

$$1 - 15 \div 2 * 20 - (9 * 18)$$

The solution is $-311.000$, which is option D.

A. $[-164.38, -155.38]$

-161.375, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[158.62, 165.62]$

162.625, which corresponds to not distributing addition and subtraction correctly.

C. $[-2846, -2839]$

-2844.000, which corresponds to not distributing a negative correctly.

D. $[-311, -310]$

* -311.000, which is the correct option.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

**General Comment:** While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$(2 - 7i)(-6 - 8i)$$

The solution is $-68 + 26i$, which is option D.

A. $a \in [43, 50]$ and $b \in [57.1, 59.8]$

$44 + 58i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-13, -10]$ and $b \in [55.7, 56.3]$

$-12 + 56i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [-75, -67]$ and $b \in [-27, -24]$

$-68 - 26i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-75, -67]$ and $b \in [24.2, 26.9]$

* $-68 + 26i$, which is the correct option.

E. $a \in [43, 50]$ and $b \in [-59.7, -57.9]$

$44 - 58i$, which corresponds to adding a minus sign in the first term.

**General Comment:** You can treat $i$ as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$(-8 + 4i)(3 + 10i)$$

The solution is $-64 - 68i$, which is option E.

A. $a \in [12, 22]$ and $b \in [92, 98]$

$16 + 92i$, which corresponds to adding a minus sign in the second term.

B. $a \in [-26, -22]$ and $b \in [37, 44]$

$-24 + 40i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [-66, -58]$ and $b \in [65, 73]$

$-64 + 68i$, which corresponds to adding a minus sign in both terms.

D. $a \in [12, 22]$ and $b \in [-98, -89]$

$16 - 92i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-66, -58]$ and $b \in [-74, -67]$

* $-64 - 68i$, which is the correct option.

**General Comment:** You can treat $i$ as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

5. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{2730}{15}} + \sqrt{110}i$$

The solution is Nonreal Complex, which is option E.

A. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

C. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

D. Irrational

These cannot be written as a fraction of Integers. Remember: $\pi$ is not an Integer!

E. Nonreal Complex

* This is the correct option!

**General Comment:** Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

6. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{0}{15}} + \sqrt{6}i$$

The solution is Pure Imaginary, which is option B.

A. Irrational

These cannot be written as a fraction of Integers. Remember: $\pi$ is not an Integer!

B. Pure Imaginary

* This is the correct option!

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

E. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has $i$ as part of the number).

**General Comment:** Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

7. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{9216}{36}}$$

The solution is Integer, which is option D.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

C. Irrational

These cannot be written as a fraction of Integers.

D. Integer

* This is the correct option!

E. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

**General Comment:** First, you **NEED** to simplify the expression. This question simplifies to $-96$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

8. Simplify the expression below and choose the interval the simplification is contained within.

$$12 - 16^2 + 8 \div 4 * 9 \div 6$$

The solution is $-241.000$, which is option B.

A. $[268.9, 274.3]$

271.000, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

B. $[-243.4, -239.4]$

* -241.000, this is the correct option

C. $[265.8, 270.5]$

268.037, which corresponds to two Order of Operations errors.

D. $[-248.1, -243.2]$

-243.963, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

**General Comment:** While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$\frac{9 - 44i}{-3 - 7i}$$

The solution is $4.84 + 3.36i$, which is option E.

A. $a \in [-7, -5]$ and $b \in [0.5, 1.5]$

$-5.78 + 1.19i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [280.5, 282]$ and $b \in [2.5, 4.5]$

$281.00 + 3.36i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [-4.5, -2]$ and $b \in [4.5, 7.5]$

$-3.00 + 6.29i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [4, 5.5]$ and $b \in [194.5, 195.5]$

$4.84 + 195.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [4, 5.5]$ and $b \in [2.5, 4.5]$

* $4.84 + 3.36i$, which is the correct option.

**General Comment:** Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

10. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$\frac{-9 - 55i}{2 - 7i}$$

The solution is $6.92 - 3.26i$, which is option A.

A. $a \in [6, 8]$ and $b \in [-5, -2.5]$

* $6.92 - 3.26i$, which is the correct option.

B. $a \in [-5.5, -3.5]$ and $b \in [7.5, 8.5]$

$-4.50 + 7.86i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [366.5, 367.5]$ and $b \in [-5, -2.5]$

$367.00 - 3.26i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [-9, -6.5]$ and $b \in [-2, 1]$

$-7.60 - 0.89i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [6, 8]$ and $b \in [-174.5, -172.5]$

$6.92 - 173.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

**General Comment:** Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

11. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{1456}{13}}$$

The solution is Irrational, which is option B.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

B. Irrational

* This is the correct option!

C. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

**General Comment:** First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{112}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

12. Simplify the expression below and choose the interval the simplification is contained within.

$$20 - 3^2 + 8 \div 5 * 10 \div 1$$

The solution is 27.000, which is option C.

A. $[11.16, 17.16]$

11.160, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[44, 55]$

45.000, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

C. $[26, 29]$

* 27.000, this is the correct option

D. $[28.16, 35.16]$

29.160, which corresponds to two Order of Operations errors.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

**General Comment:** While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

13. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$(-9 - 5i)(-8 - 10i)$$

The solution is $22 + 130i$, which is option E.

A. $a \in [114, 125]$ and $b \in [50, 53]$

$122 + 50i$, which corresponds to adding a minus sign in the first term.

B. $a \in [114, 125]$ and $b \in [-51, -49]$

$122 - 50i$, which corresponds to adding a minus sign in the second term.

C. $a \in [17, 23]$ and $b \in [-132, -126]$

$22 - 130i$, which corresponds to adding a minus sign in both terms.

D. $a \in [70, 74]$ and $b \in [50, 53]$

$72 + 50i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

E. $a \in [17, 23]$ and $b \in [129, 132]$

* $22 + 130i$, which is the correct option.

**General Comment:** You can treat $i$ as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

14. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$(4 + 7i)(-9 + 6i)$$

The solution is $-78 - 39i$, which is option C.

A. $a \in [-37, -30]$ and $b \in [39.9, 42.2]$

$-36 + 42i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

B. $a \in [4, 7]$ and $b \in [-89.3, -86.1]$

$6 - 87i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-83, -74]$ and $b \in [-40.8, -38.1]$

* $-78 - 39i$, which is the correct option.

D. $a \in [-83, -74]$ and $b \in [38.8, 41.8]$

$-78 + 39i$, which corresponds to adding a minus sign in both terms.

E. $a \in [4, 7]$ and $b \in [86.5, 89.6]$

$6 + 87i$, which corresponds to adding a minus sign in the first term.

**General Comment:** You can treat $i$ as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

15. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{1040}{0}} + \sqrt{99}i$$

The solution is Not a Complex Number, which is option D.

A. Irrational

These cannot be written as a fraction of Integers. Remember: $\pi$ is not an Integer!

B. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

C. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has $i$ as part of the number).

D. Not a Complex Number

* This is the correct option!

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

**General Comment:** Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

16. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{0}{625}} + \sqrt{8}i$$

The solution is Pure Imaginary, which is option E.

A. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

B. Irrational

These cannot be written as a fraction of Integers. Remember: $\pi$ is not an Integer!

C. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has $i$ as part of the number).

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

E. Pure Imaginary

* This is the correct option!

**General Comment:** Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

17. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{5}{0}}$$

The solution is Not a Real number, which is option E.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

C. Irrational

These cannot be written as a fraction of Integers.

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Not a Real number

* This is the correct option!

**General Comment:** First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{\frac{5}{0}}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

18. Simplify the expression below and choose the interval the simplification is contained within.

$$4 - 6 \div 19 * 5 - (20 * 13)$$

The solution is $-257.579$, which is option D.

A. $[-257.17, -255.04]$

-256.063, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[-228.8, -228.39]$

-228.526, which corresponds to not distributing a negative correctly.

C. $[263.26, 264.85]$

263.937, which corresponds to not distributing addition and subtraction correctly.

D. $[-258.68, -256.21]$

* -257.579, which is the correct option.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

**General Comment:** While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

19. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$\frac{9 + 55i}{-7 + 6i}$$

The solution is $3.14 - 5.16i$, which is option A.

A. $a \in [3, 5]$ and $b \in [-6, -5]$

* $3.14 - 5.16i$, which is the correct option.

B. $a \in [3, 5]$ and $b \in [-440, -438]$

$3.14 - 439.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-5, -3.5]$ and $b \in [-4, -3]$

$-4.62 - 3.89i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [-2, 0.5]$ and $b \in [8, 10]$

$-1.29 + 9.17i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [266.5, 269]$ and $b \in [-6, -5]$

$267.00 - 5.16i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

**General Comment:** Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

20. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$\frac{-36 - 22i}{5 + 6i}$$

The solution is $-5.11 + 1.74i$, which is option C.

A. $a \in [-312.5, -311.5]$ and $b \in [0, 2.5]$

$-312.00 + 1.74i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-5.5, -3.5]$ and $b \in [105, 106.5]$

$-5.11 + 106.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-5.5, -3.5]$ and $b \in [0, 2.5]$

* $-5.11 + 1.74i$, which is the correct option.

D. $a \in [-8.5, -6.5]$ and $b \in [-5, -2.5]$

$-7.20 - 3.67i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-2.5, 0]$ and $b \in [-6, -4.5]$

$-0.79 - 5.34i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

**General Comment:** Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

21. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{52900}{100}}$$

The solution is Integer, which is option B.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Integer

* This is the correct option!

C. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

D. Irrational

These cannot be written as a fraction of Integers.

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

**General Comment:** First, you **NEED** to simplify the expression. This question simplifies to $-230$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

22. Simplify the expression below and choose the interval the simplification is contained within.

$$13 - 3^2 + 2 \div 11 * 12 \div 19$$

The solution is 4.115, which is option A.

A. $[4.09, 4.14]$

* 4.115, this is the correct option

B. $[21.99, 22.07]$

22.001, which corresponds to two Order of Operations errors.

C. $[22.11, 22.5]$

22.115, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

D. $[3.74, 4.09]$

4.001, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

**General Comment:** While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

23. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$(-5 - 3i)(6 + 9i)$$

The solution is $-3 - 63i$, which is option A.

A. $a \in [-7, 0]$ and $b \in [-66, -61]$

* $-3 - 63i$, which is the correct option.

B. $a \in [-62, -56]$ and $b \in [24, 33]$

$-57 + 27i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-62, -56]$ and $b \in [-27, -22]$

$-57 - 27i$, which corresponds to adding a minus sign in the first term.

D. $a \in [-34, -25]$ and $b \in [-27, -22]$

$-30 - 27i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

E. $a \in [-7, 0]$ and $b \in [58, 68]$

$-3 + 63i$, which corresponds to adding a minus sign in both terms.

**General Comment:** You can treat $i$ as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

24. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$(-5 - 8i)(-3 + 7i)$$

The solution is $71 - 11i$, which is option E.

A. $a \in [-43, -35]$ and $b \in [-59, -58]$

$-41 - 59i$, which corresponds to adding a minus sign in the first term.

B. $a \in [-43, -35]$ and $b \in [56, 61]$

$-41 + 59i$, which corresponds to adding a minus sign in the second term.

C. $a \in [13, 17]$ and $b \in [-57, -49]$

$15 - 56i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

D. $a \in [69, 72]$ and $b \in [7, 12]$

$71 + 11i$, which corresponds to adding a minus sign in both terms.

E. $a \in [69, 72]$ and $b \in [-12, -7]$

* $71 - 11i$, which is the correct option.

**General Comment:** You can treat $i$ as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

25. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{9}{-7} + 25i^2$$

The solution is Rational, which is option D.

A. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

B. Irrational

These cannot be written as a fraction of Integers. Remember: $\pi$ is not an Integer!

C. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

D. Rational

* This is the correct option!

E. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has $i$ as part of the number).

**General Comment:** Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

26. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{1936}{0}} + \sqrt{154}i$$

The solution is Not a Complex Number, which is option A.

A. Not a Complex Number

* This is the correct option!

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

C. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

D. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has $i$ as part of the number).

E. Irrational

These cannot be written as a fraction of Integers. Remember: $\pi$ is not an Integer!

**General Comment:** Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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27. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{25}{0}}$$

The solution is Not a Real number, which is option A.

A. Not a Real number

* This is the correct option!

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

C. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

D. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

E. Irrational

These cannot be written as a fraction of Integers.

**General Comment:** First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{\frac{25}{0}}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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28. Simplify the expression below and choose the interval the simplification is contained within.

$$1 - 16 \div 12 * 18 - (15 * 8)$$

The solution is $-143.000$, which is option A.

A. $[-143, -138]$

* -143.000, which is the correct option.

B. $[-306, -303]$

-304.000, which corresponds to not distributing a negative correctly.

C. $[117.93, 121.93]$

120.926, which corresponds to not distributing addition and subtraction correctly.

D. $[-122.07, -113.07]$

-119.074, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

**General Comment:** While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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29. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$\frac{-27 + 44i}{1 + 6i}$$

The solution is $6.41 + 5.57i$, which is option A.

A. $a \in [4, 7.5]$ and $b \in [5, 6]$

* $6.41 + 5.57i$, which is the correct option.

B. $a \in [236.5, 237.5]$ and $b \in [5, 6]$

$237.00 + 5.57i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [-8.5, -7]$ and $b \in [-4, -2]$

$-7.86 - 3.19i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [4, 7.5]$ and $b \in [205, 207]$

$6.41 + 206.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [-27.5, -26.5]$ and $b \in [6, 8.5]$

$-27.00 + 7.33i$, which corresponds to just dividing the first term by the first term and the second by the second.

**General Comment:** Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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30. Simplify the expression below into the form $a + bi$. Then, choose the intervals that $a$ and $b$ belong to.

$$\frac{54 + 77i}{-4 + 5i}$$

The solution is $4.12 - 14.10i$, which is option E.

A. $a \in [-15, -14]$ and $b \in [-1.5, -0.5]$

$-14.66 - 0.93i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [4, 4.5]$ and $b \in [-579, -577]$

$4.12 - 578.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [168.5, 169.5]$ and $b \in [-16, -14]$

$169.00 - 14.10i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [-14, -12.5]$ and $b \in [15, 16]$

$-13.50 + 15.40i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [4, 4.5]$ and $b \in [-16, -14]$

* $4.12 - 14.10i$, which is the correct option.

**General Comment:** Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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